mum height above the plane which passes through the upper edges of the orbits and the orifices of the ears. Mr. Galton adds, that while writing his account, instruments for head measurements were being solidly constructed for him, which will be in use in Cambridge, Eng., in 1885.

THE STATUS OF AERONAUTICS IN 1884.

DUROY DE BRUIGNAC, member of the French Société des ingénieurs civils, has recently presented to that association a very complete yet concise *exposé* of the present state of the art of aeronautics, especially as related to the general system of 'dirigeable' aerostats. The first indications of success are assumed to have been given by the experiments of Giffard (1852–55), Dupuy de Lôme (1871), and Tissandier and Renard and Krebs (recently). The first condition is considered to be stability, retaining the relative position of parts seen in the earlier balloons.

Giffard, in his earliest attempts, attained a speed of three, and later of four, metres per second. Dupuy de Lôme, and Renard and Krebs, have used better forms of balloon, and have secured more rigidity of structure; but none have obtained high speed.

Extreme lightness of motor is a vitally essential feature; and the best that has yet been done is illustrated by the steam-engines of Thorneycroft, weighing about 33 kilograms (73 pounds) per horse-power, and which, by sacrificing economy of fuel, it is thought possible may be reduced to 20 kilos (44 pounds), and the various storage and other batteries yielding electricity, which, according to Tissandier, may be reduced to a weight not exceeding 25 kilos (55 pounds) per horse-power. Messrs. Renard and Krebs claim a weight as low as 17 or 19 kilos. The experiment of Tissandier in 1883, in the application of electricity to this work, is thus expected to lead to useful results.

The propelling instrument is always the screw. Its position is a matter of importance. As usually arranged, it has a tendency to cause vertical deviations of the machine, which are objectionable. It is hoped that it may prove possible to place the screw-shaft in line with the axis of symmetry of the balloon, in order to avoid this difficulty. This may be done by setting it between a pair of spindle-shaped supporting balloons. It is uncertain whether it will be found best to place it ahead or astern of the balloon; but it is presumed best at the stern. The screw is objectionable on the score of its low efficiency, — about 0.30 (?); but nothing better has yet been devised.

Bruignac proposes a formula by means of which to calculate the resistance of the aerostat, and by its application determines the relative resistances of the machines of the several aeronauts whose work has been mentioned, as follows: Giffard, 1852, 0.076; Giffard, 1855, 0.035; Dupuy de Lôme, 0.18; Tissandier, 0.12; Renard and Krebs (1), 0.12; Renard and Krebs (2), 0.02. In the last two cases, the large and the small ends of the vessel are calculated separately.

The speeds actually obtained by them were 5.5 metres per second by the last named, and from 3 to 4 metres by their predecessors. Had the former driven their machines with the small end ahead, instead of the larger end, as actually practised, the critic calculates that they might have obtained a speed of nearly ten metres. A symmetrically formed cylindrical spindle is advised as the probably best form for the body of the air-ship, inserting a straight middle body when constructing very large vessels. The larger the machine, the lighter, comparatively, will be the driving machinery. The substitution of supporting hoods, sheets, or tissues, for cords, may assist in the endeavor to reduce resistances. The loss of gas by leakage can be reduced by choice of proper material for the balloon. The waste of gas in ascending and descending must be avoided, and may, perhaps, be obviated altogether. This becomes an easier matter in ascents of the kind here contemplated, in which no greater height will be sought than is sufficient to clear obstacles safely: probably a hundred metres will prove ample. For such work, the alternate compression and expansion of the adjusting volume of gas will probably suffice.

The conclusion is reached that the art of aerostation is much nearer a practically applicable state than scientific men generally suppose. The objects now sought are the attainment of better and more stable forms, the more effective arrangement of parts, the invention of lighter motors, invariable in weight, and convenient of operation, and the securing of higher efficiency of propelling instrument. Even now, with the experience of the past, it is possible to build a machine of this class capable of making at least ten metres per second through the surrounding medium.

These conclusions of Bruignac are especially interesting when compared with those of Pole as presented to the British institution of civil engineers, in which he finds that the supporting-power of the balloons adopted by the aeronauts above mentioned, and the driving-power and weights of the torpedo-boat engines of British makers, are such as should permit the construction of an air-ship four hundred feet long, to travel at the rate of thirty miles an hour. R. H. THURSTON.

FINDING A BORE-HOLE.

Two novel and ingenious methods of locating the position of a bore-hole have recently been described in the London *Engineering*. In the first case, at Edinburgh, it was desired to connect the lower end of a bore-hole, two hundred feet deep, with a well some eighteen feet distant. A drift run in the supposed direction failed to strike the hole, although much rock was cut away, and it was evident that the drill had deviated considerably from the vertical. After an unsuccessful attempt to locate its direction

by the sound arising from shaking rods within it, Mr. Andrew Haddow, the engineer, lowered four eight-inch bar-magnets (placed end to end, with the south pole down) into the bore. The north pole of a compass-needle in the mine moved first to the west, and then to the east, of magnetic north, as the magnets were lowered, indicating that the magnets were to the westward of the compass. While the heading was being enlarged in this direction, Mr. Haddow experimented by passing a magnet around the compass, and drawing a series of curves for positions of the magnet, which produced different angular deflections of the needle. The compass was then placed successively at two different points in the heading, and the deflections caused by the magnets in the bore-hole were noted, — at one point $3\frac{7}{8}°$, at the other $6\frac{1}{2}°$. The two points were then marked on the plan of the mine, a tracing of the magnetic curves just referred to was placed over each point, and the intersection of the curves corresponding to these deflections was noted. Upon excavating to the point thus indicated, the bore was found, being about eight feet from the true vertical.

In a second case, in Australia, the diamond drill, in going down three hundred and seventy feet, had deviated beyond sensible magnetic influence, and the search by underground mining was continued for nearly twelve months without success. Mr. E. F. Macgeorge then employed glass phials partly filled with melted gelatine, and having a compass-needle in a lower connected bulb of the phial. When these were carefully lowered in the bore to different depths, and the gelatine congealed, the needle would become fixed in the magnetic north, and the surface of the gelatine would be horizontal. These two indications, when the phial was withdrawn, showed the inclination and magnetic bearing of the bore-hole at that point; and a sufficient number of observations at convenient depths permitted the erratic bore-hole to be completely mapped from top to bottom. This map showed a deviation of nearly forty feet at three hundred and seventy feet down (the point so long searched for), and of between seventy and eighty feet at the full depth of five hundred feet. A drift straight for the indicated spot found the lost bore thirty-seven feet and a half away from its proper place, and the bottom was found seventy-five feet astray. This device has since been perfected and patented.

FISHING-INTERESTS IN HUDSON BAY.

THE chief commercial value of this district undoubtedly lies in its immense fishing-interests, if we include in that term whaling and sealing.

American whaling-vessels have for more than a quarter of a century been conducting a very profitable fishery in Roe's Welcome, a large basin in the north-western portion of Hudson Bay. The vessels usually leave New England in July, and reach Marble Island in September, where they winter, one or two every season, and occasionally more. Sawing out of the ice in the following June, and pressing northward as fast as the ice will permit, they fish until about the first of September, unless sooner loaded, and then sail for home. During the eleven years preceding 1874, about fifty voyages are known to have been made; and the returns give an average of $27,420 per voyage, which shows a large margin of profit to the small sailing-vessels usually engaged in the trade. It is estimated that the aggregate value of oil and whalebone already obtained is about two and a quarter million dollars, and every thing points to a large extension of the industry.

The porpoise-fishery is extensively carried on by the Hudson-Bay company; the fish, as they are popularly called, being held in check by means of trap-nets on flats in coves where the tide rises ten or fifteen feet, and left high and dry when the water recedes. Last year the company secured nearly two hundred in one tide at Churchill, and a much larger number at Ungava Bay. The blubber weighs from two hundred and fifty to four hundred pounds, and is very rich in the finest of oil. Formerly the blubber was exported; but the company has established extensive refineries at several of its northern stations, and now ships the oil in casks.

The company also carries on a walrus-hunt, sending two sloops annually from Churchill to two very productive walrus-grounds north of Marble Island, where they have never failed to obtain full cargoes of blubber, ivory, and hides in a few weeks, besides carrying on a valuable trade in oil, ivory, musk-ox, and other skins, with the northern Eskimo.

During the exploring-steamer Neptune's visit to Stupart's Bay, the Eskimo were living on the harp-seal (Phoca groenlandica Linné), and had in their possession skins of a good many harbor and square-flipper seals (Phoca vitulina Linné, and Erignathus barbatus Fabricius), seals of all kinds being abundant.

The Hudson-Bay company has a steamer, the Diana, plying between London and Ungava Bay direct, fitted up with refrigerating apparatus, and engaged solely in conveying salmon fresh to the London market. Last year's cargo is reported to have realized eighteen thousand dollars. Nearly every stream contains both salmon and trout in vast quantities, chiefly where the salt and fresh waters mingle.

Cod abound in the vicinity of Chudleigh, though not up to the present time found in Hudson Bay. Newfoundland schooners even now work as far north as Nachvak, and seem to be going farther each year. The cod, though good, are not equal to those of the Banks. While the Neptune was at Port Burwell, both in going and on returning, the anchorage teemed with cod, which were taken in great numbers by jigging from the ship's deck.

THE DRAINAGE SYSTEM OF BRAZIL.[1]

THE hydrographic features of Brazil are to a certain extent determined by the orographic system, and by the distribution of mountains and plains described

[1] From the Rio *News*.